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Adoption of smart cities strategies in the United Kingdom: An empirical study

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- **Summary**

Rapid urbanisation growth is causing a variety of technical and infrastructure-oriented challenges to cities around the world. Therefore, cities urgently need innovative organisational and institutional arrangements to enhance cities performance, liveability and sustainability. Many leaders choose to transform cities into "smart cities." The aim of this paper is to explore the importance of key smart cities strategies deployed by various SMEs and large organisations in the UK. A web-based questionnaire survey method was employed to collect data. Statistical analyses were undertaken using the Statistical Package for Social Sciences (SPSS). The survey revealed that strategies focus on environmental sustainability, such as smart energy, smart infrastructure, smart waste management, smart mobility, and smart water are the most important smart cities strategies. Whereas strategies such as smart financing, smart surveillance, smart manufacturing, and smart governance are less important. The paper concludes that it is necessary to cities to recognise the important smart cities strategies that reflect and respond to citizens' needs and interests.

Keywords: Cities, citizens, smartness, smart mobility, smart water management and smart energy

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Introduction

Cities around the world are increasingly facing complex challenges (Gil-Garcia *et al*., 2015). Many cities are experiencing exponential growth as people move from rural areas in search of better jobs and education (Khatoun and Zeadally, 2016). The world's urban population will double from 2.6 billion in 2010 to 5.2 billion in 2050 (United Nations, 2011). Rapid growth in urban populations is causing a variety of technical and infrastructure-oriented problems. While this shift has improved the life of many, the explosion of urban populations has led to far-reaching problems in many cities around the globe (Laufs *et al*., 2020). Khatoun and Zeadally, (2016) noted that cities' demographic, economic, social, and environmental conditions are the major reasons for the dramatic increase in pollution, congestion, noise, crime, terrorist attacks, energy production, traffic accidents, and climate change. Smart cities is an emerging strategy aiming to improve the quality of life of citizens using the most innovative technologies to support the specific needs of each city (Dameri *et al*., 2019).

Cities today are the major contributors to the climate problem. They cover less than 2% of the Earth's surface yet consume 78% of the world's energy, producing more than 60% of CO_2 emissions. Cities will face challenges concerning growth, performance, competitiveness, cities basic functionality, and residents' livelihoods (McKinsey and Company, 2013). Therefore, cities urgently need innovative organisational and institutional arrangements to solve a great variety of extant and emerging technical, physical, and social problems (Gil-Garcia *et al*., 2015; Khatoun and Zeadally, 2016). Therefore, cities leaders must design new strategies to enhance city performance and sustainability. Many leaders choose to transform cities into "smart cities", as a new socioeconomic environments in which citizens, enterprises, and governments can more efficiently access services and resources (Letaifa, 2015). Khatoun and Zeadally, (2016) noted that a smart city is an ultra-modern urban area that addresses the needs of businesses, institutions, and especially citizens.

On the other hand, Dameri *et al*., (2019) noted that the technological development, and especially innovative technologies such as ICT, opens new ways to face urban problems and to create development opportunities for inhabitants and firms. Additionally, Angelidou (2016) highlighted the powerful and transformative impact of technological advancements of recent decades on urban life. The wide availability of Information and Communication Technologies (ICTs) in urban settings and their broad adoption throughout society have created a state of technological ubiquity in developed countries. As technology advances and becomes more affordable, the functionality and sustainability of urban systems undergoes significant advancements as well (Angelidou, 2016). Khatoun and Zeadally, (2016) suggest that a city is "smart" if it provides better efficiency for urban planning through a variety of technologies.

Smart Cities, with a proper roadmap, will serve people at large and will surely help in reducing man power for the long term. Though, the concept of smart city is still evolving in the minds of people, few studies have attempted to address the questions regarding the development of smart cities (Joshi *et al*., 2016). Improving energy use, waste management, mobility, water management, healthcare, and education entails the design of a strategy that integrates all of city sectors in a global and well-articulated systemic vision, among other strategies have been developed to meet the growing challenges and to enhance cities social development and economic growth.

Despite the considerable attention to the development of smart cities, the smart cities strategies are less evident in the smart city literature. The current literature reveals the need for more

empirical research on the experience of existing smart city strategies. This paper investigates the importance of smart cities strategies that have been developed to accomplish the implementation of smart cities initiatives and to achieve smartness of cities.

Smart cities

The concept of "smart cities" is still emerging and defining it, still a work in progress (Dameri *et al*., 2019; Chourabi *et al.*, 2012, Nam and Pardo, 2011). Letaifa (2015) noted that Smart city is a relatively new concept that is highly context dependent. For several authors the conceptualization of smart city is mostly based on the use of information and communication technologies. For example, Al-Hader and Rodzi, (2009) noted that Smart cites has widely been defined to refer to the increasing scope to which cities are deploying (ICT) in different urban structures and management systems. For instance, wireless, virtual, and ubiquitous technologies and infrastructures offer benefits to city dwellers with mobile lifestyles. Anavitarte and Tratz-Ryan (2010) argue that a smart city is "an urban area functioning and articulated by modern information and communication technologies in its various verticals, providing ongoing efficient services to its population". Similarly, Washburn *et al*., (2010) defined a smart city as "the use of Smart Computing technologies to make the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation, and utilities – more intelligent, interconnected, and efficient."

However, authors from different disciplines are increasingly proposing definitions that go beyond the use of information technologies (Gil-Garcia *et al*., 2015). Hollands (2008) defines smart city as an urban labelling phenomenon, particularly in terms of what the label ideologically implies, which could be very different for different people and in different situations. Similarly, Boulton *et al*., (2011) call for a conceptualization of smart city that disentangles the diverse aspects of a city as a phenomenon. Some authors argue that smart city characterizes a city capable of sustaining social, environmental, economic, and cultural progress (Caragliu *et al*., 2011; Chourabi *et al*., 2012; Gil-Garcia *et al.*, 2015). Therefore, while broadband and wireless are key elements of city infrastructure, they are only one of multiple elements and should be seen only as a first step towards becoming smart (Al-Hader and Rodzi, 2009). Table 1 summarise the components of smartness in cities based review of literature.

Khatoun and Zeadally (2016) concluded that a smart city can be defined as "a city seeking to address public issues via information and communication technology (ICT)-based solutions on the basis of a multi-stakeholder, municipality based partnership." From these various definitions it can be deduced that ICT plays a pivotal role in developing a smart city that can adapt to the needs of its citizens (Khatoun and Zeadally, 2016). The term "smart city" is increasingly being used to reflect and emphasize both technological aspects, in addition to the development of human capital or physical infrastructure (Gil-Garcia *et al.*, 2015). Technology in a smart city comprises various elements including interconnected computing networks, ubiquitous systems, virtual technologies, and service-oriented architectures, among others (Kuk and Janssen, 2011; Nam and Pardo, 2011; Naphade *et al.*, 2011). Khatoun and Zeadally, (2016) noted that smart cities aims to enhance the lives of its citizens and optimize economic, and environmental resources. Smart cities generates multiple benefits including; energy management, safety and security, environment and transportation, educational facilities, tourism, and citizens' health (see Table 2).

Because this paper focusses largely on the importance of smart cities strategies and implications for urban planning and decision making, it adopts the definition suggested by Hollands (2015) of a smart city as "a city made up of IT services, industry and business, governance and urban services, neighbourhoods, housing and people, education, buildings, lifestyle, transport and the environment".

Table 1: Components of "smartness" in cities based on review of literature

References	*Component of "smartness"*			*Definition insights*
	Physical capital	*Social capital*	*Both*	
Giffinger *et al*., (2007)			x	Integrate ICT into cities critical infrastructures to enhance cities liveability and sustainability.
Washburn *et al*., (2010)			x	Using ICT to enhance cities infrastructure (e.g. healthcare, public safety) efficiency and connectivity.
Hollands (2015)		x		Deployment ICT to support social and urban growth; focusing on citizens involvement and governmental efficiency.
Caragliu *et al.*, (2011)		x		Deploying ICT to simulate high quality of life
Al-Hader and Rodzi, (2009)	x			Increasing scope of ICT deployment in different urban structures and management systems
Anavitarte and Tratz-Ryan (2010)	x			Focuses on articulating urban areas functionality by ICT in its various verticals
Khatoun and Zeadally (2016)			x	Addressing public issues via information and communication technology (ICT)-based solutions
Hancke *et al.*, (2013)	x			Integrating all cities infrastructures and services into a cohesive whole and using ICT for monitoring and control.
Komninos (2009)		x		cities with high capacity for creativity, knowledge creation, learning and innovation, supported by deploying ICT.
Snow *et al.*, (2017)			x	Using ICT to enhance connectivity, performance and well-being, reduce costs and resource consumption
Angelidou (2014)			x	Cities integrate their human, collective, and technological capital for the enhancement of development and liveability.
Dubbeldeman and Stephen (2015)	x			Smartness of cities exist on the intersection of digital technology, disruptive innovation and urban environments.
Letaifa (2015)			x	Supports a alanced centricity among technology, institutions and people.
Airaksinen *et al.*, (2016)			x	Efficient use of ICT to enhance cities infrastructure, environmental sustainability, and societal development, and people's wellbeing.
Joshi *et al*., (2016)			x	Supports leverage from technology and establish smarter systems that can optimize the use of limited resources, and provide a sustainable development, enhance economic, political conditions
Ardito *et al*., (2019)		x		Perceives technology as a component of smart cities that can be deployed to enhance cities knowledge and intellectual capital.

Table 2: Smart cities benefits

Domain	**Description**
Energy management	Including timely energy billing. Optimal energy management and saving.
Environment and transportation	Controlled pollution levels, smart street lights, congestion rules, and new public-transport solutions to reduce car use.
Educational facilities	Improving educational opportunities. Lifelong learning, education through remote learning, Smart devices in classrooms.
Safety and security	Surveillance cameras, Enhanced emergency- response services, Automated messages for alerting citizens; Real-time information.
Citizens' health	Using ICT to improve people's health. Access to high-quality affordable healthcare. Wireless body-area network technology.

Source: Khatoun and Zeadally (2016)

Smart cities strategies

Ensuring sustainable development and quality of life in complex social ecosystems of cities and urban areas are important concerns. Cities are increasingly aware of the concept of "smart city" and are actively developing strategies towards the goal of becoming "smart" and manage city resources more efficiently while addressing development and inclusion challenges (Joshi *et al*., 2016). In their comprehensive study to investigate the concept of smart cities and its implementation, Joshi *et al*., (2016) identified six critical factors that form significant pillar for the development of a smart city namely; social, management, economy, legal, technology and sustainability (see Table 3). Similarly, Letaifa (2015) in agreement with Khatoun and Zeadally (2016) noted that the six most-common components of smart cities are smart economy, smart people, smart governance, smart mobility, smart environment, and smart living. Moreover, Joshi *et al*., (2016) noted that the study (Dirks *et al*., 2009) released by the IBM Institute for Business Value, the authors identify core systems required for the development of smarter cities strategies, which comprise citizens system, business and transport system, services system communication system, water and energy system (Figure 1).

Gil-Garcia *et al*., (2015) identified key components to evaluate cities strategies "smartness" including public services, city administration, policies, engagement, social capital, knowledge economy, city infrastructure, environmental sustainability, and ICT and technologies (see Table 4 for summary of findings). Efficient and effective production and delivery of critical city services are pivotal to smart cities (Gil-Garcia *et al*., 2015). The authors identified a list of core public services domains including; transportation, public safety, surveillance and emergency response and management. The service domains reflect the primary challenges that cities currently face due to the high density of people in relatively small areas (Nam and Pardo, 2011). On the other hand, cities need to become more efficient, more liveable and provide better quality of life, business opportunities and security to achieve social inclusiveness and social sustainability (Joshi *et al*., 2016).

Table 3: Six critical factors for the development of smart cities strategies

Factor	Description
Social	The idea of smart cities is based on smart communities whose citizens can play an active part in their design.
Management	Improving decision making, policy-making and public governance. Enhance democratic processes and increase opportunities to interact with the government.
Economy	The economic outcomes of the smart city initiatives are business creation, job creation, workforce development, and improvement in the productivity.
Legal	Both political and legal components are crucial for smart city development. Smart cities policies must conform to both technical and non-technical requirements of cities.
Technology	Smart cities must exploit ICT in different urban structures and management systems to increase sustainability and improve quality of life.
Sustainability	Aims at becoming more competitive for capacity, opportunity & investment by providing an enhanced quality of life and decreases environmental consequences of urban life.

Source: Joshi *et al*., (2016).

The literature reveal that sustainability is one of the major strategic elements of a smart city (Yigitcanlar and Velibeyoglu, 2008; Caragliu *et al*., 2011, Gil-Garcia *et al*., 2015; Haller et *al.*, 2018). The idea of compactness for future urban growth is a conceptual strength of a smart city strategy, as it supports a more sustainable treatment of natural assets. Environmental sustainability is one of the core concepts and major strategic elements of smart cities, which refers to the ecological implications of urban growth and development. To diminish the impact of cities on the environment resource it is vital to encourage the effective and intelligent deployment of technology and to integrate infrastructures (Joshi *et al*., 2016). Hollands (2015) highlighted the focus on the sustainability issues of cities and, more specifically, on their environmental sustainability as a rationale to base mega smart cities developments on. Smart cities aims at tackling the growing urbanisation problems in addition to enhancing citizens' quality of life. Accomplishing smart cities sustainable development encompass the major requirements of city environments comprising of sustaining water, energy, mobility, waste management and reducing greenhouse gas emission (Joshi *et al*., 2016).

Airaksinen *et al.*, (2016) noted that international climate targets and EU 2030 targets drive cities to increase the energy efficiency, use of renewable energy, and reduce of environmental impacts. Khatoun and Zeadally (2016) noted that significant increase in global energy consumption is one of the key drivers that led government and industrial institutions to deploy the smart cities concept. Smart energy strategies aim at using many energy sources, greener energy generation, lower energy consumption, and at minimising the carbon emissions through

developing real time energy demand management and optimisation techniques with the capability to predict the energy demand (Zhou *et al*., 2016).

Table 4: The key components to evaluate cities strategies "smartness"

Component	Description
Public services	Transportation, public safety, health and social services, surveillance and emergency response and management.
City administration and management	Using the appropriate technological means, while being endowed with an efficient organizational structure.
Policies institutional arrangements	Laws, regulations, norms are important in government settings when selecting, adopting, designing, implementing, and using ICT.
Governance, engagement, and collaboration	Smart cities need to enable citizen participation and engagement in collective decision-making efforts about important public affairs.
Social capital	Smart people, Social infrastructure and human infrastructure are crucial axes for smart city development.
Knowledge economy	Smart city planners need to enable taking advantage of local knowledge and intellectual capital of the population.
City infrastructure	Allowing highly interconnected subsystems, devoted to better coordinating the issues raised by rapid urbanization.
Environmental sustainability	Comprising of sustaining water, energy, and food supplies, managing water and reducing greenhouse gas emissions.
ICT and technologies	Comprises various elements including interconnected computing networks, virtual technologies, and service-oriented architectures.

Source: Gil-Garcia *et al*., (2015)

Traffic congestion and mobility issues represent obvious problem in today's cities (Christidis and Rivas; 2012; Gil-Garcia *et al*., 2015). Letaifa (2015) noted that urban planning is the best way to achieve smart mobility. Within smart cities, urban planning moves the focus from individual to collective modes of transportation through the extensive use of information and communications technologies (ICT). Dubbeldeman and Stephen (2015) claimed that smart mobility solutions focus on reducing congestion and adopting improved, cleaner, faster, and cheaper transportation choices, including both improvements to the current transportation network and solutions that create whole new transportation systems. Smart mobility strategies also can be used to optimize the use of parking spaces, by providing drivers with real time information on the nearest free parking spaces and their price. For example, Westminster City Council's SmartPark solution utilises a network of over 3,400 radio-frequency identification (RFID) equipped in-ground vehicle detection sensors in order to provide motorists with real-time information on unoccupied car parking spaces (Thompson, 2019). Additionally, Smart solutions can provide great potential for making additional parking space available that enables

using privately owned parking spaces outside the using time, which allows new forms of public-private partnerships (Dubbeldeman and Stephen , 2015).

Smart water is also one of the important smart cities strategies. Dubbeldeman and Stephen (2015) stated that water is one of the most important resources in urban areas, highlighted that the lack of water will be one of the 21st century's biggest urban challenges. Hancke *et al.*, (2013) noted that the distribution of water has to be done efficiently and has to be regulated. The authors added that efficient quality control has to be performed to ensure that water is safe for human consumption. Dubbeldeman and Stephen (2015) claimed that smart water strategies aim at minimizing waste and securing quality as one of the pillars of sustainability. Smart water strategies offer leakage detection, pollution detection, advanced warning for flooding, predictive maintenance planning and Just in time waste collection. Snow *et al.*, (2017) noted that examples of such strategies include monitoring the content level in reservoir tanks, leak detection and monitoring the water quality at specific points along the distribution system.

Azam *et al.,* (2016) noted that with the increasing population, increasing urbanization, and change in the lifestyle, waste management has become a challenge not only for the developing countries, but also for the developed ones. Relying on landfilling as a disposal of waste has resulted in space limitation, health issues, and environmental problems. City administrations and waste management organizations in different metropolises face the challenge to provide efficient and effective system to collect, dispose-off properly, and recycle the waste. Dubbeldeman and Stephen (2015) argued that most cities use some type of waste management strategies to collect the waste produced by households, which are normally operated on fixed routes. As a result, some waste containers are emptied when they are only half full and some are emptied days after they became full. Zhang and Huang (2014) suggested that having a proper notification and data availability about the type and quantity of recycling material, in addition to enabling effective stakeholders' involvement in the process is one of the best ways to tackle waste management and recycling issues. Therefore, one of the suggested smart solutions is to equip the waste containers with sensors that detect the volume of the waste in the container. This data is used to enhance the number of garbage trucks and their routes, skipping containers that are not yet full and making an early stop at containers that are close to reaching their limit, which, in turn, brings about a cheaper process and elimination of full waste containers (Abarca-Guerrero *et al*., 2015).

According to Angelidou (2014) integrating physical design and development of smart infrastructures and buildings, incorporating all aspects of edge technology, modern amenities and best practices of city planning are of the most important advantages of applying a smart city strategy. Infrastructure systems constitute the foundation of modern societies, and provide the basis for everyday life. Ogie *et al.,* (2017) noted that the societal demand on infrastructure assets is growing rapidly, with high expectations in terms of productivity and service delivery. "Smart infrastructure", wherein enabling technologies such as connected sensors and big data analytics are integrated with physical infrastructure in order to achieve real-time monitoring, efficient decision-making and enhanced service delivery. The potential benefits of smart infrastructure include decreased maintenance costs, reduced damage and disruption costs, increased quality and value of service, as well as protecting human life; all these benefits contribute to sustainable urban growth (Ogie *et al*., 2017).

Land use development is highly capital intensive, and often it is hindered by legal issues and lack of public acceptance (Airaksinen *et al*., 2016). Accordingly, planners require tools to manage natural resources, pollution, information, and trade (Khansari *et al*., 2014). Solutions

to these issues include of enhancements to a majority of components of urban dynamics. In 2013, Mckinsey Global Institute concluded that, globally, $400 billion a year could be saved by "making more existing infrastructure" through improved demand management and maintenance. That is where digitalisation, in form of big data, can help. The comprehensive and strategic use of information can advance anticipating and help to nudge behaviour in means that increase the reliability of transport infrastructure and increase its efficiency and utilization.

Hancke *et al.,* (2013) noted that physical safety is a significant factor for thriving economies and citizens' wellbeing. With the availably of conventional CCTV systems for surveillance purposes, an infrastructure for smart surveillance systems already exists. Security, especially in urban areas, is of paramount importance. Although these cameras are typically connected to a digital video recorder (DVR), most only record and do not have any built-in intelligent processing capabilities. Furthermore, these systems are run by human operators who are prone to loss of concentration. The benefits of using smart surveillance are obvious. For instance, by monitoring peoples' actions, it is possible to determine whether violent actions are taking place, and even trying to identify and recognize the people involved (Hancke *et al.,* 2013). Memos *et al*., (2018) noted that using real-time video analysis enables faster response to an activity in real time. In this context, smart surveillance systems could alert users by triggering alerts when events of interest take place. On the other hand, Gou *et al.,* (2017) noted that several security challenges, such as privacy issues must be considered in order to be regarded as secure (Gou *et al.,* 2017).

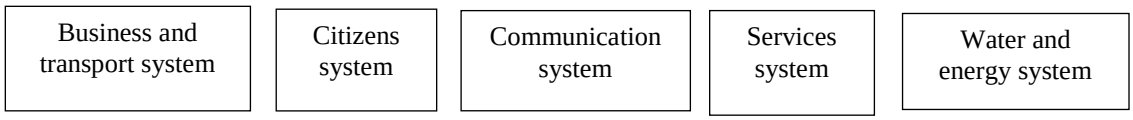

Figure 1: Core systems required for development of smarter cities strategies

Developing smart cities requires proposing integrated city vision and developing policy instruments to achieve those visions. Yigitcanlar and Velibeyoglu (2008) noted that it is necessary to establish an administrative environment to support the development of smart cities. An enhanced level of smart governance is a capability necessary for smart cities (Gil-Garcia *et al*., 2015). Local authorities must not only use the appropriate technological means (infrastructure, hardware, and software), but also be endowed with an efficient organizational structure and consider important management and policy aspects (Santinha *et al.,* 2010; Gil-Garcia *et al*., 2015; Haller *et al*., 2018). In a broader sense, institutional arrangements (e.g., laws, regulations, norms, and others) are important key components in government settings when selecting, adopting, designing, implementing, and using information technologies (Gil-Garcia *et al*., 2015; Joshi *et al.,* 2016). Funding and staffing are also important aspects of the organizational capacity necessary to enable and promote smart city initiatives (Gil-Garcia *et al.,* 2015). Anand and Navío-Marco (2018) highlighted various challenges for implementing smart governance strategies including efficiency, collaboration, economic performance, social exclusion, ecological performance, city branding.

Gil-Garcia *et al.,* (2015) noted that smart governance, engagement by stakeholders, citizens, and communities, and collaboration are the main elements for efficient governance, engagement, and collaboration within smart cities context. Smart cities need to enable citizen participation and engagement in collective decision-making efforts about important public affairs (Walters, 2011; Gil-Garcia *et al*., 2015). Joshi *et al.,* (2016) noted that a move from the

regular governance characteristics (limited transparency, fragmented accountability, unequal city divisions and leakage of resources) to digital or e-governance is essential for an effective and efficient administration of the smart cities. Smart governance includes political and active participation, citizen services and the smart use of e-Government. Internet enables greater participation, as it incapacitates the restrictions imposed by geography, disabilities or other factors. It also enables access to information by individuals and groups that had not been included previously.

Kusiak (2018) noted that smart manufacturing integrates manufacturing assets integrated with sensors, computing platforms, communication technology, data intensive modelling, control, simulation and predictive engineering. Smart manufacturing offers opportunities and challenges. The greatest challenge could be in the acceptance of the emerging manufacturing reality and change. Also, cybersecurity and safety issues will remain a challenge to be continuously addressed. Davis *et al*., (2012) noted that smart Manufacturing objectives are not just about applying IT but also it promises to energize innovation, address productivity, achieve new and structurally different performance goals, and drive the competitive advantage of investments.

Lehmann *et al.,* (2017) examined the role of smart finance to generate smart growth. The study imply that the provision of smart finance turns the balance towards the smart regions and cities. Smart finance works as a strong complement by providing the necessary financial resources to spur new smart growth. However, Hamilton and Zhu (2017) noted that budget limitation and not having the capacity to develop smart cities programmes are the main inhibiting factor for implementing smart cities programmes. At the same time, public budgets are inadequate to fund the necessary changes of smart cities development. Therefore, seeking smart financing solutions to bridge the funding gap between current budgets and needed budget for investments is considered a crucial need for the development of smart cities.

Xu and Lu (2018) noted that smart construction, an essential part of smart city, aims at revamping the construction industry with a robotics revolution to cut project costs, increase precision, decrease waste, accelerate resilience and sustainability. Smart construction resources (e.g. machinery, tools, materials, and structures) are made smart with sensing, computing, networking, reacting and communication abilities so that they have autonomy and awareness, and can interact with the vicinity to enable better decision making (Niu *et al*. 2016).

Nam and Pardo, (2011) noted that people, education, learning, and knowledge are of central importance to smart cities. Smart people is one of the most-common indicators of smart cities. Social capital drives this dimension. Smart people are the result of ethnic and social diversity, tolerance, creativity, and engagement (Letaifa, 2015). Social infrastructure and human infrastructure are crucial axes for smart cities development (Caragliu *et al*., 2011; Gil-Garcia *et al*., 2015). Higher education and the existence of a knowledge workforce support sustainable economic development in a city. The high proportion of well-educated people and knowledge workers is considered an important element for smarter cities (Letaifa, 2015; Gil-Garcia *et al.,* 2015). On the other hand, cities struggle with high crime rates and the difficulties of delivering sufficient social and health services (Gil-Garcia *et al.,* 2015). Letaifa (2015) also highlighted the importance of improving life quality of citizens in terms of services, enhancing cities attractiveness, and promoting social cohesion by promoting safety, e-health, social services, and public safety tools, smart sensors and wireless platforms. Projects of smart cities have an impact on the quality of life of citizens and aim to foster more aware, educated and informed

citizens. Also, smart cities initiatives allow the citizens to participate in the governance and management of the city and become active users. Smart city is about all citizens, not just a group of enthusiasts. It is about daily chores and everyday life (Joshi *et al*., 2016).

Moreover, smart economy is one of the core components that makes cities smart. Joshi *et al*., (2016) note that operational definition of a smart economy includes factors all around economic competitiveness as entrepreneurship, trademarks, innovation, productivity and flexibility of the labour market and the integration in the national and global market. Additionally, with the emergence of the knowledge economy, more knowledge-intensive than labour-intensive activities take place in urban areas, which ask smart city planners to develop cities that take advantage of local knowledge and intellectual capital of the population, promote new businesses, and facilitate access to information both locally and internationally (Hollands, 2008; Ardito *et al*., 2019). The economic component of a smart city stresses a knowledge economy, high-tech industry, creative industry, and a business-friendly or pro-business environment in order to attract new businesses (Letaifa, 2015; Gil-Garcia *et al*., 2015). A knowledge economy primarily involves research and development, technology transfer, and technological innovation as a hotbed for innovative industries (Gil-Garcia *et al*., 2015).

Classifications of smart cities strategies: physical and social capital

The literature emphasised two main categories of smart cities strategies. Strategies designed to target the efficiency and technological advancement of the city's hard infrastructure systems (i.e. smart mobility, smart energy, smart water, smart waste management, smart construction, smart land use, smart manufacturing, and smart infrastructure) or the social/ human infrastructure and the people of the city (smart healthcare, smart governance, smart surveillance, smart safety, smart education, and smart financing) (see Table 5).

The smartness of cities can be attained by investing in hard infrastructures that make city subsystems highly interconnected and will allow the optimization of actions devoted to better coordinating the issues raised by the rapid urbanization (Ardito *et al*., 2019). Better infrastructure and technologies improve customer experience (e.g., smart mobility or smart health). Thus, the customer experience drives technology choice (Letaifa, 2015). However, technological endowment can be seen as recourse for the development of smart cities based on the belief that by instrumenting a city technically and investing in hard infrastructure, an output of enhanced service provision in different areas of the urban life and consequently development will be achieved. Infrastructure-oriented smart city products provide replicable solutions that address a range of common problems; these solutions can later be applied to many cities with minor modifications. However, a large fraction of smart city advocates tends to regard infrastructure-oriented strategies as fragmented, stressing the idea that 'Technology is not enough', meaning that it does not guarantee the real smartness of cities, and it actually does not necessarily make people themselves think or act smart (Hollands, 2008; Nam & Pardo, 2011; Angelidou, 2014; Angelidou, 2016; Ardito *et al*., 2019). On the other hand, a more complete view on smart city development is adopted, by taking advantage of all available recourses, including the knowledge, creativity and intellectual capital of the populace. A significant portion of the smart city literature has argued extensively about the importance of human and social capital for the development of smart cities (e.g. Hollands, 2008; Chourabi *et al*., 2012; Letaifa, 2015; Angelidou, 2014; Joshi *et al*., 2016; Ardito *et al*., 2019). Summary of smart cities strategies adopted based on the literature review is presented in Table 6.

Table 5: Physical and social capital strategies in smart cities summarised from literature findings

Smart cities strategies	
Physical capital	*Social/ Human capital*
Smart mobility strategies: • Shift from individual to collective modes of transportation. • Focus on reducing congestion and adopting improved, cleaner, faster, and cheaper transportation choice.	***Smart governance strategies:*** • Enable citizen participation and engagement in collective decision-making efforts about important public affairs. • Includes active participation and the smart use of e-Government.
Smart energy strategies: • Using many energy sources, lower energy consumption, and at minimising the carbon emissions.	***Smart healthcare strategies:*** • Using ICT to improve people's health. Access to high-quality affordable healthcare. Wireless body-area network technology.
Smart water strategies: • Aim at minimizing waste and securing quality. Offer leakage and pollution detection, advanced warning for flooding, predictive maintenance planning and Just in time waste collection.	***Smart surveillance strategies:*** • Determine whether violent actions are taking place, identify and recognize people involved. Enable faster response in real time. Could alert users by triggering alerts when events of interest take place.
Smart waste management strategies: • Offer economic and environmental advantages, higher efficiency help to raise public awareness, improve cities sanitation, encourage recycling, enhance better decision making and planning.	***Smart finance strategies:*** • Providing the necessary financial resources to spur new smart growth. Considered a crucial need for the development of smart cities.
Smart infrastructure strategies: • Real-time monitoring, enhance decision-making, service delivery and quality of service. Reduce maintenance, damage and disruption costs.	***Smart education strategies:*** • Improving educational opportunities. Lifelong learning, education through remote learning, Smart devices in classrooms.
Smart Land use strategies: • Enhancements to a majority of components of urban dynamics. making more existing infrastructure" through improved demand management and maintenance	
Smart construction strategies: • Aim at cutting project costs, increase precision, decrease waste, and accelerate resilience and sustainability. Offer autonomy and awareness, and can interact with the vicinity to enable better decision making.	
Smart manufacturing strategies: • It promises to energize innovation, address productivity, achieve new and structurally different performance goals, and drive the competitive advantage of investments.	

Table 6: Summary of smart cities strategies findings based on the literature review

Source	**strategies**																**Description**
	Smart energy	Smart water	Smart governance	Smart mobility	Smart construction	Smart people	Smart surveillance	Smart financing	Smart healthcare	Smart education	Smart environment	Smart buildings	Smart manufacturing	Smart land use	Smart waste management	Smart infrastructure	
Walters (2011)			X														Smart cities need to enable citizen participation and engagement in collective decision-making efforts about important public affairs. Social capital
Christidis and Rivas (2012)	X			X													Traffic congestion mitigation is the main priority because of its major consequences on the environment, users' safety, and economy.
Davis *et al*., (2012)													X			X	Energize innovation, address productivity, achieve new and structurally different performance goals, and drive the competitive advantage of investments.
Hancke *et al*., (2013)		X					X										Using ICT to efficiently distribute and regulate water. Safety is a significant factor for thriving economies and citizens' wellbeing.
Angelidou (2014)									X	X						X	Smart city strategies are aimed at ensuring the integration of ICT with city strategy to improve standard of living, economic, and social conditions.
Khansari *et al*., 2014														X			City planners need to consider a complex system consisting of both economic and environmental subsystems.
Zhang and Huang (2014)	X														X		Smart waste management strategies is important to mitigate GHG emissions and it is only possible with timely notification and collection of waste.
Abarca-Guerrero *et al*., (2015)															X		Enables efficient and smarter way of reporting the waste and creating means for the recycling agencies to analyse data about the generated waste material.

Hollands (2015)	X			X												Focussed on innovations in transportation and urban mobility & energy systems and environmental sustainability.
Angelidou (2016)	X		X													ICT and the significant advancement on functionality and sustainability of urban systems.
Azam *et al.*, (2016)	X					X								X		Using ICT and data availability in addition to stakeholders' engagement to improve waste management.
Dubbeldeman and Stephen (2015)	X													X		Smart waste management brings about a cheaper process and elimination of full waste containers. Using ICT to enhance urban systems and quality of life.
Gil-Garcia *et al.*, (2015)	X		X	X		X	X			X						Emphasize both technological aspects, in addition to the development of human capital or physical infrastructure. Identified key components to evaluate cities "smartness". Both social and physical capital.
Letaifa (2015)	X		X	X		X					X					Smart cities integrates technology, institutions, and people. The holistic urban system, or ecosystem, allows co-creation among all stakeholders.
Airaksinen *et al.*, (2016)	X			X										X		Smart cities is about how technology is deployed in a comprehensive approach to support the city functioning more efficiently.
Bing *et al.*, (2016)														X		Importance of having a smart way of notifying the quantity of each type of waste and involve the stakeholders effectively.
Joshi *et al.*, (2016)																Cities need to become more efficient, liveable and to enhance quality of life, business and security to achieve social inclusiveness and sustainability.
Khatoun and Zeadally (2016)	X			X			X		X	X						Smart cities seek to address public issues via ICT.
Niu *et al.* (2016)					X											Smart construction strategies have autonomy and awareness needed to enable better decision making.
Gou *et al.*, (2017)							X									There are many benefits of integrating smart surveillance strategies. However, security issues should be considered. Using ICT to enhance safety and security.

Hamilton and Zhu (2017)								X								Smart financing is considered a crucial need for the development of smart cities. Budget limitation is the main inhibiting factor for smart cities projects.
Ogie *et al*., (2017)	X		X												X	Enabling technologies are integrated with physical infrastructure in order to achieve real-time monitoring, efficient decision-making and enhanced service delivery.
Snow *et al*., (2017)		X														Include monitoring the content level in reservoir tanks, leak detection and monitoring the water quality at specific points along the distribution system.
Anand and Navío-Marco (2018)			X													Challenges to smart governance; including: economic and ecological performance, citizen-centric services, social exclusion, integral vision and collaborative governance. Both physical and social capital.
Kusiak (2018)					X								X			Highlighted the acceptance of the emerging manufacturing reality and change, in addition to cybersecurity and safety issues as the main challenges to smart manufacturing.
Memos *et al*., (2018)							X									Using real-time video analysis enables faster response to an activity in real time, both physical and social capital.
Xu and Lu (2018)					X											Aims at cut project costs, increase precision, decrease waste, accelerate resilience and sustainability.
Ardito *et al*., (2019)			X			X										Taking advantage of local knowledge and intellectual capital to promote new businesses, and facilitate access to information.
Laufs *et al*., (2020)							X									Smart surveillance strategies recognise security threats in real time.

Research methodology

Research is defined as the process by which a person attempts to find an answer to a question or a solution to a problem through a systematic methodology with the aid of an evident fact (Leedy and Omrod, 2012). It is not only a set of skills but a way of thinking, by looking at a situation inquisitively, analytically and critically so as to gain an in-depth understanding of its relevance, rational, efficiency and effectiveness (Kumar, 2014). According to Collis and Hussey (2013) research methodology can be defined as the overall approach to the research process, from the theoretical underpinnings to the collection and analysis of the data, so research methodology in social enquiry refers to far more than simply the methods adopted. It should encompass the rationale and philosophical assumptions that underlie a particular study. These, in turn, influence the methods that are used to investigate a problem and to collect, analyse, and interpret data.

Given the relatively new and unexplored nature of the research problem at hand, a quantitative method was adopted to collect and analyse data. The philosophical underpinning of this is based on objectivist-positivist paradigms. According to Bourque and Fielder (2003) questionnaire survey instruments have many advantages in the data collection process. They provide a larger geographical coverage for the sample population than case studies or semi structured interviews could provide and are cost-effective, efficient, and permit anonymity. The latter helps ensure that individuals' responses reflect their true beliefs and feelings—especially important in research involving attitudes. Because the researcher is not conversing directly with participants, they are unlikely to influence respondent answers. The questionnaire survey also provides a uniform situation for data collection, because each person is presented with the exactly the same method of inquiry, in the same manner (Bell *et al*., 2018).

A web-based, online survey was used to collect data. This offers many advantages including low cost, speed, and ability to reach respondents globally (Punch, 2005). A robust questionnaire survey design is fundamental to obtaining reliable survey results and an appropriate response rate. Hence, these aspects are further explained in the following sections (Bell *et al.,* 2018). Questionnaire variables used in the study were derived from the literature review. The specific questions were written with focus on the response process, the utility of individual questions, and the overall structure and appeal of the questionnaire. The cover page introduced the research project and provided critical information such as a confidentiality statement and important notes for completing the questionnaire (Naoum, 2012). According to Naoum (2012), three typical question types are used in questionnaire surveys: open ended and closed ended for types of question format, and scaled items for opinion questions which require subjective measurement. The study included scaled items for opinion questions. The final page of the questionnaire provided an option for respondents to offer any further general comments relating to the area of research. Respondents were also able to request a summary of the survey findings to encourage a higher response rate. Fellows and Liu (2015) noted that Likert items are concerned with determining respondents' degrees of agreement or disagreement with a statement, usually on a 5-point or 7-point scale. Renukappa *et al*., (2017) noted that a general problem occurs in the application of opinions or attitude scales in questionnaire surveys: respondents tend towards the neutral position. That is, when asked to strongly agree or strongly disagree on a 5-point or 7-point scale, many respondents would prefer to choose "neither agree nor disagree." Analysts often exclude neutral responses from their analysis, thereby risking the exclusion of valid responses. The disadvantage of this among surveys is that it reduces the quantity and quality of remaining data. Therefore, a 4-point Likert item was used in the study to avoid this.

The sampling technique used was convenience sampling. In convenience sampling, elements for the sample are selected for the convenience of the researcher, hence the researcher typically chooses target respondents who are readily available, nearby, or perceived as willing to participate (Black, 2019).

Survey invitations were e-mailed to respondents requesting that they submit their views via an online survey. After preliminary analysis of the data, the number of usable responses amounted to 65 from small and medium enterprises (SMEs) and large organisations. Saunders *et al.*, (2009) argue that a minimum number (i.e. effective responses) for statistical analysis should be 30 responses. Therefore, 65 responses were deemed appropriate for a survey of this kind.

Statistical analyses were undertaken using the Statistical Package for Social Sciences (SPSS). These included descriptive statistical analysis and the t-test to compare equality of mean responses between SEMs and Large organisations. This test is appropriate for comparing the means of two large, independent samples; two independent samples of any size; two dependent samples; or a sample mean and a known mean (Weiers, 2011). Cronbach's α was calculated as a way of determining the internal consistency, or average correlation of items, in the questionnaire to gauge its reliability (Nunnaly 1978). The Cronbach's α statistics were in the range of 0.81–0.93. This implies a high degree of internal consistency in the responses to the individual measures, as α values above 0.7 are acceptable indicators in this respect (Nunnaly 1978).

Findings and discussion

Through the online survey, respondents were asked to indicate the importance of smart cities strategies on a 4-point Likert item: "not important" (1), "fairly important" (2), "important" (3), "very important" (4). It is apparent from Table 7 that the five most important smart cities strategies are: smart energy (3.63), smart infrastructures (3.6), smart waste management (3.57), smart mobility (3.54), and smart water (3.54). Whereas the five least important smarty cities strategies are as follows: smart financing (3.22), smart surveillance (3.26), smart manufacturing (3.34), smart land use (3.35) and smart governance (3.35).

Table 7: Level of importance of smart cities strategies

Strategy	Overall	SEMs	Large	t_{cal}	Significant value(ρ)
Smart infrastructures	3.60	3.60	3.60	0.000	0.999
Smart governance	3.35	3.35	3.36	-0.050	0.960
Smart mobility	3.54	3.48	3.64	-1.102	0.275
Smart healthcare	3.52	3.55	3.48	0.373	0.710
Smart buildings	3.45	3.48	3.40	0.401	0.690
Smart water	3.54	3.60	3.44	0.913	0.365

Smart land use	3.35	3.43	3.24	0.983	0.329
Smart waste management	3.57	3.63	3.48	0.971	0.335
Smart safety	3.48	3.55	3.36	1.086	0.282
Smart education	3.52	3.53	3.52	0.029	0.977
Smart energy	3.63	3.55	3.76	-1.285	0.204
Smart manufacturing	3.34	3.31	3.40	-0.458	0.648
Smart construction	3.46	3.48	3.44	0.205	0.838
Smart financing	3.22	3.28	3.12	0.707	0.482
Smart surveillance	3.26	3.30	3.20	0.439	0.663

The t-test for equality of means was carried out to investigate whether there were any significant differences between participants of 'SMEs' and 'large organisations' insights on the importance of smart cities strategies (at the 0.05 significance level) (refer Table 7). According to Black et al. (2010), in the t-test, a significant value (ρ) below 0.05 indicates a high degree of difference of opinion between groups on that variable (in this case, between participants of 'SMEs' and 'large organisations'). Results here show that all smart cities strategies are not significant (>0.05), and therefore, there are no significant statistical variations between the responses of the 'SMEs' and 'large organisations'.

The most important smart cities strategies

It is apparent from Table 7 that smart energy, smart infrastructure, smart waste management, smart mobility, and smart water are the top five most important smart cities strategies. This suggests that environmental sustainability is one of the core concepts and major strategic elements of smart cities. For instance, in this study, overall mean value of 3.63, smart energy is the most important strategy for development of smart cities initiatives. Cities are responsible for major energy consumption and CO2 emission. Energy consumption is increasing with the growing population that is harming our environment and resulting in high energy demand. According to Lim *et al.*, (2019) smart energy strategies can be used to gather energy consumption data so that it can aid optimizing energy distribution and consumption and saving. Karunakaran *et al.*, (2018) noted that smart energy strategies can contribute to energy generation, distribution and storage, and consumption systems to increase energy efficiency and reduce CO2 emission. Furthermore, Letaifa (2015) noted that the use of innovative technologies deployed in smart energy strategies such as solar energy and other renewable sources of electricity, can also enhance the natural environment. Therefore, it is evident that smart energy strategies are significantly important to enhance energy consumption by deploying advanced metering, energy storage, and energy management systems. The utilisation of big data analytics enable optimization of energy use on-demand, and enhances stable energy distribution. Energy consumption patterns can be monitored through smart metering and accumulated data can aid better decision-making.

In this study, overall mean value of 3.6, smart infrastructure is the second most important smart cities strategy. Smart infrastructure facilitates service integration, collaboration, communication and data exchange. Hence it enhances capacity, efficiency, and reliability and improves services. According to Airaksinen *et al*. (2016) the success of smart cities will be critically dependent on robust smart infrastructures, this emerges the issues relating to resilience, and planning for failure of critical systems, as service interruptions and failures of equipment are likely to have a significant impact and serious disruption of society and economy. Moreover, Dubbeldeman and Stephen (2015) noted delivering smart infrastructure that is controlled in real time; would bring a more functional society, better risk management, and savings in financial and physical resources. Therefore, smart infrastructures including city administration, education, healthcare, public safety, real estate, transportation, and utilities makes cities infrastructures more interconnected, and efficient. It supports social and urban growth through improving the economy, citizens' involvement, and high quality of life, as well as governmental efficiency. Additionally, it enhances resources consumption, plan better preventive maintenance activities, and monitor security aspects while improving services delivery to citizens."

With an overall mean value of 3.57, "smart waste management" is the third most important smart cities strategy, supporting the notion that smart waste management is an essential requirement for the development of smart cities (Azam *et al*., 2016). Abarca-Guerrero *et al*., (2015) emphasize the importance of an efficient and smarter way of reporting the waste and creating means for the recycling agencies to analyse the quantity and timing of the generated relevant waste material. Zhang and Huang (2014) highlighted the importance of in-time collection of solid waste, since waste management activities result in releasing Greenhouse Gases (GHGs) in to the atmosphere which results in global climate change. Therefore, deploying smart waste management strategies to mitigate GHG emissions is very important and is only possible with timely notification and collection of waste. In conclusion, in addition to offering economic and environmental advantages, as well as higher efficiency in terms of resources and costs, smart waste management also help to raise public awareness of utilizing renewable energy, improve cities sanitation, encourage recycling, and to collect and analyse area-specific data on waste volumes for better decision making and planning. Bing *et al.*, (2016) emphasise the importance of having a smart way of notifying the quantity of each type of waste and involve the stakeholders effectively.

In this study, 'smart water' and 'smart mobility' (both with a mean value of 3.54) are the fourth most important smart cities strategies. Water is one of the most important resources in urban areas. Lack of water is one of the major challenges encounter cities. Growing urbanisation increased the demand for water. Therefore, effective water management strategies are required to ensure efficient water distribution, regulation, quality control and also to ensure that water is safe for human consumption. Smart water strategies offer leakage and pollution detection, advanced warning for flooding, predictive maintenance planning and just in time waste collection (Dubbeldeman and Stephen, 2015). Snow *et al*., (2017) noted that smart water solutions aim at minimizing waste and securing quality as one of the pillars of sustainability. Hancke *et al*., (2013) noted that smart water strategies allows monitoring the content level in reservoir tanks, fault and detection and monitoring the water quality at specific points along the distribution system. In summary, smart water strategies is considered one of the major strategic elements for the development of smart cities.

Mobility is a critical factor, and a key facilitator of smart sustainable development. Growing urbanization and continuing car dependence lead to inevitable traffic problems; including

congestion, emissions and safety issues. Christidis and Rivas (2012) noted that traffic congestion mitigation is the main priority of most infrastructure, traffic management and road charging measures because of its major consequences on the environment, users safety, and economy (e.g. the cost of road congestion in Europe is equivalent to an estimated 1% of GDP). Moreover, according to the European Commission (2018) road fatalities are increasing in many cities and comprised 37% of Europe's total traffic fatalities in 2017. Christidis and Rivas, (2012) suggest that the reason for congestion in many cases is not a lack in capacity of road infrastructure, but rather an issue of demand management. Therefore, tackling traffic congestion problems requires integrated interventions and measures to traffic management. Airaksinen *et al.*, (2016) noted that in smart cities' vision, transport is a low carbon system in which transport and mobility needs of people are fulfilled, and users are supported to utilize different modes sustainably. Smart mobility strategies can help transport authorities meet strategic goals by minimizing vehicle emission levels and reducing traffic congestion. Smart mobility strategies offer traffic management services such as adaptive traffic light management, road user information, and dynamic changes in traffic capacity. For example, cloud-based smart parking solutions provides accurate real data on parking space usage. Other smart mobility strategies such as bike-share or electric scooter-share aim to improve the customer's quality of life, contribute to urban sustainability, and reduce CO2 emissions. In addition to providing dynamic real time information and enhancing communications with passengers and users experience, smart mobility strategies also offer a wider range of affordable, multimodal, on-demand mobility options; and conventional cars and ownership practices are replaced by shared electric and autonomous vehicles. Smart mobility strategies could yield considerable benefits by enhancing safety, reducing road fatalities, improving travel times, recovering billions of hours lost to commuting and congestion, and generating total benefits to society.

The least important smart cities strategies

In this study, smart financing (3.22), smart surveillance (3.26), smart manufacturing (3.34) are least important smart cities strategies as shown in Table 7. Smart cities projects require large capital investments. Funding for these projects presents a significant challenge. Hamilton and Zhu (2017) noted that budget limitation and not having the capacity to develop smart cities programmes are the main inhibiting factor for implementing those programmes. At the same time, public budgets are inadequate to fund the necessary changes of smart cities development. Therefore, seeking smart financing solutions to bridge the funding gap between current budgets and needed budget for investments is considered a crucial need for the development of smart cities. However, smart financing strategies requires specialist financier, one who has a deep understanding of both the challenges and requirements of smart cities initiatives financing. Hence, customised packages can be offered, tailored to fit the city's particular circumstances. Memos *et al*., (2018) noted that the term "smart surveillance" denotes the ability of real-time video analysing in relevant surveillance applications. The main advantage of smart surveillance strategies is the application of video compression technology, which can multiplex effectively or store images from a large number of cameras onto mass store devices. By using real-time video analysis, smart surveillance systems can respond to an activity in real time, gathering the important information at much higher resolution. There are many benefits of integrating smart surveillance strategies. However, this integrated scheme carries several security challenges, such as privacy issues, which must be considered in order to be regarded as secure (Gou *et al*., 2017). Kusiak (2018) noted that smart manufacturing integrates manufacturing assets of today and tomorrow with sensors, computing platforms, communication technology, data intensive modelling, control, simulation and predictive engineering. Smart manufacturing offers

opportunities and challenges. The greatest challenge could be in the acceptance of the emerging manufacturing reality and change. Also, cybersecurity and safety issues will remain a challenge to be continuously addressed. Ogie *et al*., (2017) noted that the concept of smart infrastructure has been applied in several areas, including electricity distribution, water and waste services, automatic toll collection, intelligent transport systems, emergency services and the monitoring of critical infrastructure assets such as tunnels, bridges and dams.

Smart land use (with a mean value of 3.35) is another least important smart cities strategy in this study. Smart land use strategies require enhancements to a majority of components of urban dynamics (Airaksinen *et al*., 2016). Therefore, city planners need to consider a complex system consisting of both economic and environmental subsystems. Accordingly, planners require tools to manage natural resources, pollution, information, and trade (Khansari *et al.*, 2014). The challenge for city managers, planners, and mayors is to decide as to what extent these smart land use strategies should be incorporated into their operations and how to go about implementing them. In this study smart governance (with a mean value of 3.35) is another least important smart cities strategy. Although smart governance is an important dimension for the development of smart cities. However, issues of digital inclusion, inclusive delivery of public services, new forms of participation in the decision-making or transparent governance, among other represent key challenges to smart governance strategies. Anand and Navío-Marco (2018) noted that economic performance, citizen-centric services, social exclusion, ecological performance, smart governance interaction, city branding, efficient government, integral vision and collaborative governance represent real challenges to smart governance.

In summary, smart governance can be seen as basis to smart, open and participatory government. However, the inherent potentially negative effects of technology also need to be considered, e.g. the exclusion of certain categories of the general population. Also, in some case, government departments don't wish to engage public in every activity they do. Sometimes due to security and political reasons they try to maintain a distance with the public. Therefore, smart governance is not of the most important smart cities strategies based on this study findings.

Conclusions and recommendations

The paper presented a theoretical basis on the concept of smart cities and the deployed smart cities strategies. It also generated some insight to understand the linkage between the developed smart cities strategies and the core components of a smart city. Smart cities strategies have also been looked closely by this research and it has been found from the results that having a robust and applicable strategy is important in order to ensure that the implementation is done accordingly. Smart city is indeed a multidimensional and multifaceted concept and, therefore, the validity of any city's claim to be smart should be evaluated on the basis of various components. The strategies of smart cities are designed in such a manner that the quality of life of society is improved. The current literature on the current smart cities strategies covers various areas under different categories. The paper concludes that the strategies developed for the implementation of smart cities requires integrating physical and social city capitals.

The survey revealed that smart energy, smart infrastructures, smart waste management, smart mobility, and smart water are the most important smart cities strategies. It supports the notion that environmental sustainability is one of the core concepts and major strategic elements of smart cities. It is surprising to see that smart infrastructure is one of the most important strategies. Smart infrastructure provides the foundation for all of the key smart cities strategies,

including smart energy, smart mobility, smart waste management, smart governance and smart healthcare. It enables integration and connectivity, which is crucial to ensure the optimal use of resources and improve performance. Whereas smart financing, smart surveillance, smart manufacturing, smart land use and smart governance are the least important smart cities strategies. The paper concludes that to successfully implement smart cities initiatives, it is necessary to recognise the important smart cities strategies. It is advisable that smart cities strategies are made through collaborative stakeholder engagement with city stakeholders and citizens. It is also important to ensure that smart cities strategies are aligned with existing strategies in order to ensure strategies successful implementation. It is also recommended to consider a collaborative approach when creating smart cities strategies that harness citizens' and businesses' capabilities and respond to their needs. In turn, it is more likely to result in greater long-term involvement of the citizens as the process offers the basis to improve their awareness, ownership, transparency and credibility.

Despite the novel insights provided by this study, it has some limitations. Given that the research reported in this paper is a preliminary study, the results presented are of quite limited value for the purpose of generalisability. Furthermore, although the sampling technique used for this study was convenience sampling, which is based on respondents who are readily available, nearby, or perceived as willing to participate, and the number of responses were deemed appropriate for a survey of this kind. However, another relatively larger sample size might open new insights to understand and quantify the most and least important smart cities strategies as well as how their importance change in different organisations' size. Moreover, the study tried to avoid the exclusion of valid responses by deploying a 4-point by Likert item instead of the 5-point or 7-point scale where respondents tend towards the neutral position. Yet, the findings show no significant differences between the two groups. However, we argue that the results obtained are useful and provide valuable resource for future research.

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